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Published in:
Proceedings of the 17th Nordic Process Control Workshop

Publication date:
2012

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):
Engoulevent, F. G., & Jørgensen, J. B. (2012). Simulation, Control and Optimization of Single Cell Protein Production in a U-Loop Reactor. In J. B. Jørgensen, J. K. Huusom, & G. Sin (Eds.), *Proceedings of the 17th Nordic Process Control Workshop* (pp. 203). Technical University of Denmark. <http://npcw17.imm.dtu.dk/>

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Simulation, Control and Optimization of Single Cell Protein Production in a U-Loop Reactor

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Abstract: In 2011, the world population passed 7 billions inhabitants. While this number witnesses the success of humankind on earth, it also rises among other things questions about food supply. Declining live stock in the wild, rising price of energy combined with climatic change give a new economic potential for alternative sources of protein production.

Single cell protein (SCP) is protein produced by growth of micro organisms. Among these micro organisms, *Methylococcus Capsulatus* is particular interesting as it can grow on either methane or methanol and contains 70% protein. The U-Loop reactor is particular useful for production of SCP by *M. Capsulatus* as it has good gas-liquid mass transfer capabilities and also the capability to remove the significant amount of heat developed by the reaction.

In this paper we describe an implementation of a model to simulate SCP production in the U-Loop reactor. We report simulation results. In addition we design and compare different regulatory control systems for regulation of SCP production in the U-Loop reactor. The purpose of the regulatory control systems is to keep the process at a steady state and to reject disturbances. We design and implement such control systems based upon PID and MPC technology. In particular, we design these control systems such that they can be used as the regulatory layer in a process control hierarchy and enable resilient transition from one operating point to another. The optimal operating points are determined by the real-time optimization (RTO) part of the control system.

Keywords: Single Cell Protein, Simulation, Control, Optimization, PID, MPC, Real-Time Optimization
